

## Profit Maximization by a Perfectly Competitive Firm

A perfectly competitive firm will maximize its total profit by producing the output level at which marginal revenue equals marginal cost. You need to understand how economists find these two important “marginal” measures.

### Part A: Revenue Measures of a Perfectly Competitive Firm

A perfectly competitive firm is a “price taker.” This means it has no control over price and will charge the market-determined price for its product. In fact, because it is such a small participant in the market, a perfectly competitive firm can sell all the output it wants at the market price. It does not have to reduce its price to sell additional units. This makes the revenue measures of a perfectly competitive firm easy to calculate and to graph.

1. Assume the market for yo-yos is perfectly competitive and that the market price currently is \$17 per box of yo-yos. Complete Table 3-6.1, which has the three revenue measures of a typical firm in this market. Put the MR values at the new output level. For example, when the firm increases output from four to five units, its total revenue increases by \$17, so put “+\$17” in the MR column for  $Q = 5$ .



Table 3-6.1

### Revenue Measures of a Perfectly Competitive Firm

(1) Output (Q) [boxes of yo-yos]	(2) Price (P) [per box]	(3) Total revenue $TR = P \times Q$	(4) Marginal revenue $MR = \Delta TR / \Delta Q$	(5) Average revenue $AR = TR / Q$
0	\$17		—	—
1	\$17			
2	\$17			\$17
3	\$17	\$51		
4	\$17			
5	\$17		+\$17	
6	\$17			
7	\$17			\$17
8	\$17	\$136		
9	\$17			
10	\$17			

2. What happens to the value of MR as more output is sold? Why?
3. What is the relationship between MR and AR at every output level? Why?
4. What happens to the value of TR each time the firm sells one more unit of its good? Why?
5. Why is P equal to \$17 at every level of Q?
6. What is the relationship between P, MR, and AR? Why?

**Part B: Cost Measures of a Perfectly Competitive Firm**

The short-run cost curves of a perfectly competitive firm give you values of the various cost measures at different output levels.

16. Complete Table 3-6.2, which has the seven cost measures of a typical firm in this market. Put the MC values at the new output level. For example, when the firm increases output from four to five units, its total cost increases by \$4, so put “+\$4” in the MC column for Q = 5. Some of the cost values are provided for you.



Table 3-6.2  
**Cost Measures of a Perfectly Competitive Firm**

(1) Output (Q) [boxes]	(2) Total fixed cost (TFC)	(3) Total variable cost (TVC)	(4) Total cost (TC)	(5) Marginal cost (MC) = $\Delta TC/\Delta Q$	(6) Average fixed cost (AFC) = $TFC/Q$	(7) Average variable cost (AVC) = $TVC/Q$	(8) Average total cost (ATC) = $TC/Q$
0			\$40.00	–	–	–	–
1		\$10.00					
2	\$40.00			+\$6.00			
3						\$7.00	
4							\$16.50
5		\$30.00		+\$4.00			
6						\$6.00	
7			\$85.50		\$5.71		
8	\$40.00						\$12.00
9		\$72.00					
10				+\$18.00			

### Part C: Profit Maximization by a Perfectly Competitive Firm

Now that you have mastered the revenue and cost terms for a perfectly competitive firm, you can bring them together to determine how many units of output the firm should produce to maximize its total profit.

31. Complete Table 3-6.3 using your data from Tables 3-6.1 and 3-6.2. Some data have been entered for you.



Table 3-6.3

#### A Perfectly Competitive Firm Maximizes Total Profit

Q	TR	TC	TΠ	MR	MC	MΠ
0		\$40.00	-\$40.00	—	—	—
1					+\$10.00	
2	\$34.00			+\$17.00		
3			-\$10.00			+\$12.00
4		\$66.00			+\$5.00	
5				+\$17.00		
6	\$102.00					+\$11.00
7			\$33.50			
8		\$96.00			+\$10.50	
9				+\$17.00		+\$1.00
10	\$170.00					

32. The value of TΠ is greatest at Q = \_\_\_\_\_ units. The maximum TΠ = \$\_\_\_\_\_.
33. The firm should produce each unit for which  $MR > MC$ . The last unit with  $MR > MC$  is the \_\_\_\_\_ unit, which has  $MΠ = \$$ \_\_\_\_\_.
34. Should the firm produce the tenth unit of Q? Why?

35.  $MP$  has its greatest value at  $Q =$  \_\_\_\_\_ units. Should this be the  $Q$  level the firm decides to produce? Why?
36. Go back to Figure 3-6.3 and draw the firm's  $TR$  function. (You can get it from Figure 3-6.1). Label the function " $TR$ ."
37. What do we call the vertical gap between the  $TR$  and  $TC$  curves?
38. We saw in Table 3-6.3 that this firm should produce  $Q =$  \_\_\_\_\_ units to maximize its  $T\Pi$ . Indicate the part of Figure 3-6.3 that represents this maximum  $T\Pi$ .
39. Go back to Figure 3-6.4 and draw the firm's  $D$ ,  $MR$ , and  $AR$  functions at the current market price of \$17. (You can get these from Figure 3-6.2). Label the functions.
40. The last unit of output for which  $MR > MC$  is the \_\_\_\_\_ unit. This is the last unit the firm should produce in order to maximize its  $T\Pi$ .
41. What does the vertical gap between the  $MR$  and  $MC$  curves represent?

### Part D: When Is a Firm's Best Just Not Good Enough?

You proved this firm can earn a positive total profit if the market price is \$17. But what if the market price drops? Since a perfectly competitive firm is a price taker, it will have to sell its product at the lower market price, which will reduce its total profit.

42. Assuming all its costs are unchanged, what will happen to the perfectly competitive firm if the market price drops to \$10? In Figure 3-6.4, draw a new " $D_1 = MR_1$ " line at the price of \$10.
- (A) Based on a comparison of MR and MC, the firm's optimal Q level is \_\_\_\_\_ units.
  - (B) Its TR will be (*greater than / equal to / less than*) its TC at this Q level.
  - (C) Its TR will be (*greater than / equal to / less than*) its TVC.
  - (D) What should the firm do? Choose one of these decisions:
    - (1) It should produce its optimal Q even though it will make a loss.
    - (2) It should shut down and produce no Q this period.
43. Assuming all its costs are unchanged, what will happen to the perfectly competitive firm if the market price drops to \$5? In Figure 3-6.4, draw a new " $D_2 = MR_2$ " line at the price of \$5.
- (A) Based on a comparison of MR and MC, the firm's optimal Q level is \_\_\_\_\_ units.
  - (B) Its TR will be (*greater than / equal to / less than*) its TC at this Q level.
  - (C) Its TR will be (*greater than / equal to / less than*) its TVC.
  - (D) What should the firm do? Choose one of these decisions:
    - (1) It should produce its optimal Q even though it will make a loss.
    - (2) It should shut down and produce no Q this period.

*Note:* Even though economists chant, "Produce where  $MR = MC$ ," in a discrete case with a limited number of Q levels being considered, there might not be a level of Q where  $MR = MC$ . In such a case, the firm should produce units for which  $MR > MC$  and stop before it produces units for which  $MR < MC$ . That's what you did in this example.

44. A puzzle for you! Economists say a perfectly competitive firm can sell at the Q it wants at the going market price. So why doesn't a single firm decide to produce all the Q that is demanded in the market?

## Long-Run Equilibrium and Long-Run Supply in Perfect Competition

A firm is in a *short-run equilibrium (SRE)* position when it maximizes its total profit by producing the output level where marginal revenue equals marginal cost:  $MR = MC$ . When firms in short-run equilibrium in a perfectly competitive market are earning positive total profits, other firms will enter the market. If firms are making a loss in their short-run equilibrium position, over time some of the firms will exit the market. Eventually the perfectly competitive market reaches a *long-run equilibrium (LRE)* where all of the firms in the industry are earning zero total profits, based on the current market demand. Firms in other industries thus have no incentive to enter this market. And firms in this market have no incentive to leave it because they are earning their normal profit. An industry's *long-run supply (LRS)* curve is the set of LREs where each LRE is based on a different level of market demand. The shape of the LRS curve depends on how the production costs of firms change as the industry expands. The three cases to consider are *constant-cost*, *increasing-cost*, and *decreasing-cost industries*.


### Part A: Movement from Short-Run Equilibrium to Long-Run Equilibrium

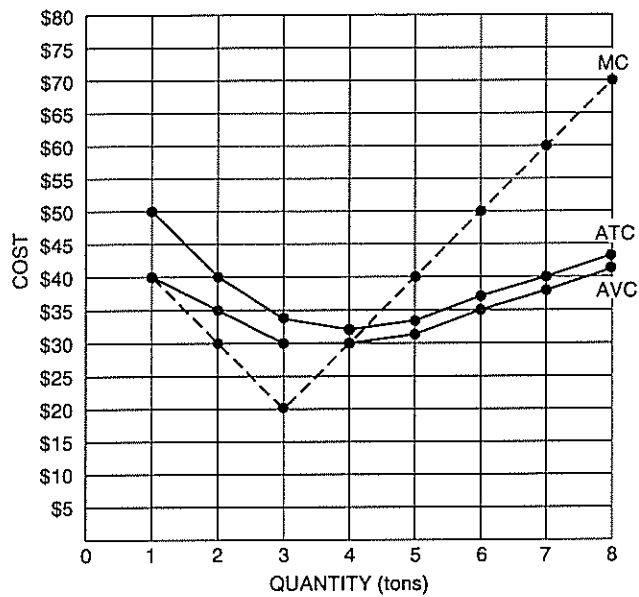
Table 3-8.1 presents some cost data for a typical firm in the perfectly competitive market for bricks. These cost data are shown in Figure 3-8.1.




Table 3-8.1  
Cost Data for a Typical Perfectly Competitive Firm

Output (Q) (tons)	Average total cost (ATC)	Average variable cost (AVC)	MC
0	—	—	—
1	\$50.00	\$40.00	+\$40.00
2	\$40.00	\$35.00	+\$30.00
3	\$33.33	\$30.00	+\$20.00
4	\$32.50	\$30.00	+\$30.00
5	\$34.00	\$32.00	+\$40.00
6	\$36.67	\$35.00	+\$50.00
7	\$40.00	\$38.57	+\$60.00
8	\$43.75	\$42.50	+\$70.00

 **Figure 3-8.1**  
**Cost Functions of a Typical Firm**



- Complete Table 3-8.2, which shows how many units a firm will make available at different prices. Assume a firm cannot produce fractions of a unit.

 **Table 3-8.2**  
**Supply Schedule of a Typical Firm**

Price (P)	Quantity supplied ( $Q_s$ ) (tons)
\$70	
\$60	
\$50	
\$40	
\$30	
\$20	
\$10	



2. Assume there are 1,000 firms in the brick industry. Complete Table 3-8.3, which shows the market supply schedule. Information about the market demand schedule is included in Table 3-8.3.



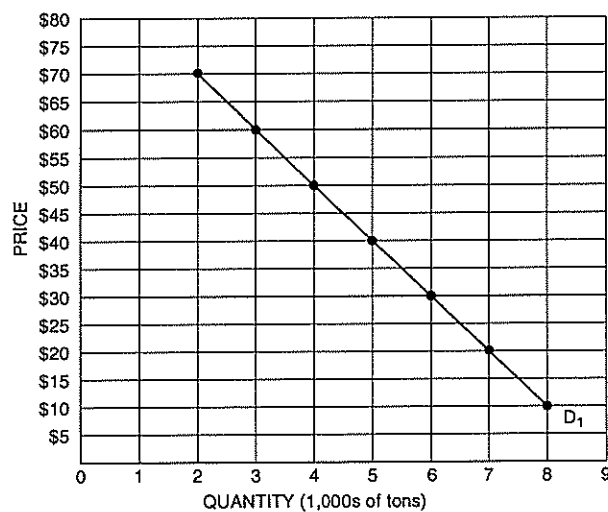
Table 3-8.3  
Market Supply and Demand Schedules

P	$Q_s$ (tons)	Quantity demanded ( $Q_d$ ) (tons)
\$70		2,000
\$60		3,000
\$50		4,000
\$40		5,000
\$30		6,000
\$20		7,000
\$10		8,000

3. Figure 3-8.2 shows the market demand curve  $D_1$ . Draw the market supply curve  $S_1$  from Table 3-8.3. What is the equilibrium price of bricks? What is the equilibrium quantity? Label the SRE intersection of  $D_1$  and  $S_1$  as "SRE."



Figure 3-8.2  
The Market for Bricks



4. In Figure 3-8.1, draw the marginal revenue ( $MR_1$ ), average revenue ( $AR_1$ ), and demand ( $D_1$ ) curves of a firm at the equilibrium price. How many units will the firm produce to maximize its total profit? (Assume the firm cannot produce fractions of a unit.) Does this number agree with your work in Table 3-8.2?
  
5. What is the value of the firm's average profit? What is the value of its total profit? In Figure 3-8.1, shade in the area representing its total profit.
  
6. Is the industry in a position of LRE? How do you know?
  
7. Why will other firms want to enter this industry? Assume the cost curves of a typical firm in the industry do not change as new firms enter.
  
8. As more firms enter the industry, the market supply curve shifts to the (*right / left*), which makes the market price (*increase / decrease*).
  
9. The industry is in a position of LRE when all firms break even based on the current level of market demand  $D_1$ . What is the LRE price? Why?
  
10. In Figure 3-8.2, draw the new market S curve (label it  $S_2$ ) that will result in this LRE price. Do not change the existing market demand curve  $D_1$ . Label the LRE point as "LRE."

11. In Figure 3-8.1, draw the firm's  $MR_2$ ,  $AR_2$ , and  $D_2$  curves at the LRE price. How many units will the typical firm produce at this price? What is the total profit of a firm in this LRE position?
12. If all firms in the market earn \$0 in economic profit, will other firms still want to enter the market? Will some firms want to exit the market? Why?

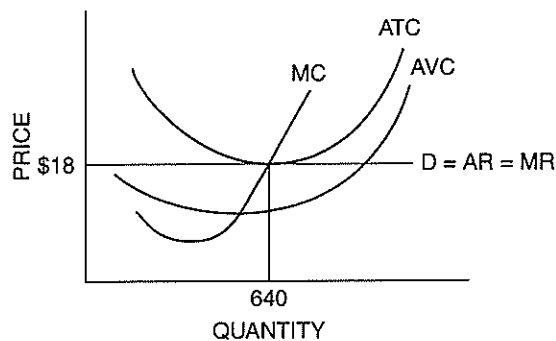
### Part B: Long-Run Equilibrium for a Perfectly Competitive Firm

Let's leave the brick market and move to some other perfectly competitive market. Figure 3-8.3 shows a perfectly competitive firm in LRE, selling 640 units at a price of \$18.



Figure 3-8.3

#### A Perfectly Competitive Firm in Long-Run Equilibrium



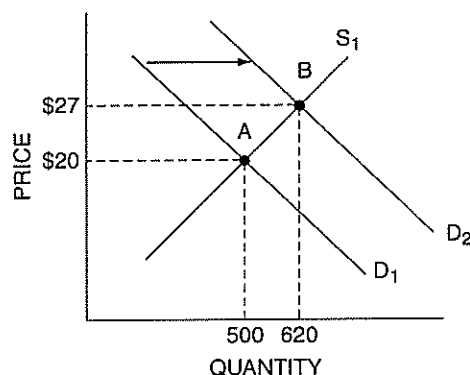
13. What does it mean for a firm to be productively efficient? Is this firm productively efficient? How do you know?
14. What does it mean for a firm to be allocatively efficient? Is this firm allocatively efficient? How do you know?

### Part C: Long-Run Supply for a Perfectly Competitive Industry

The industry shown in Figure 3-8.4 is in LRE at point A with supply curve  $S_1$  and demand curve  $D_1$ . The market price is \$20, and the equilibrium quantity is 500 units. Now the demand for the industry's product increases to  $D_2$ . The price increases to \$27 and quantity increases to 620 units. Because this boost in the market price results in positive total profits for firms in the industry, point B is considered a *short-run equilibrium (SRE)*. How the industry moves to its new LRE in response to this increase in demand depends on whether it is a constant-cost, increasing-cost, or decreasing-cost industry.



Figure 3-8.4  
A Perfectly Competitive Industry



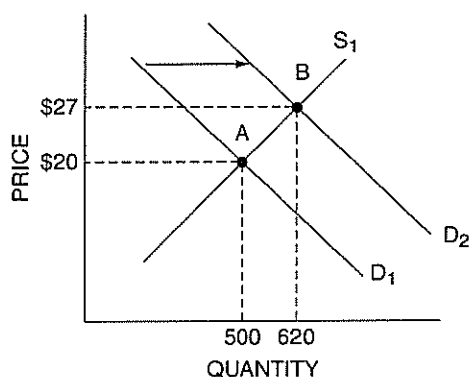
15. Assume the industry is a constant-cost industry. Explain how the industry moves to its new LRE. Show changes in supply and/or demand in Figure 3-8.4 and indicate the new LRE as point C.
16. Is the new LRE price greater than, equal to, or less than \$20? Why?
17. The industry's LRS curve is the collection of LREs where each LRE is based on a different market demand curve. Draw a line connecting point A and point C, and label this line as "LRS." Is the LRS curve of a constant-cost industry upward sloping, horizontal, or downward sloping? What does this tell you about how price and quantity change as the industry expands in response to increases in demand?

18. Now assume the industry is an increasing-cost industry. In Figure 3-8.5, the industry is in LRE at point A. When demand increases to  $D_2$ , the industry moves to SRE at point B, where firms enjoy positive total profit. Explain how the industry moves to its new LRE. Show changes in supply and/or demand in Figure 3-8.5 and indicate the new LRE as point C.



Figure 3-8.5

**A Perfectly Competitive Industry**



19. Is the new LRE price greater than, equal to, or less than \$20? Why?
20. Draw a line connecting point A and point C, and label this line as “LRS” for long-run supply. Is the LRS curve of an increasing-cost industry upward sloping, horizontal, or downward sloping? What does this tell you about how price and quantity change as the industry expands in response to increases in demand?
21. If the industry were a decreasing-cost industry, what would happen to the market price and quantity as the industry expanded? What would be the shape of the industry LRS curve?

## Graphing Perfect Competition

Figures 3-9.1 through 3-9.6 show side-by-side graphs of perfectly competitive industries and firms. Each pair of graphs illustrates the specific situation that is given.

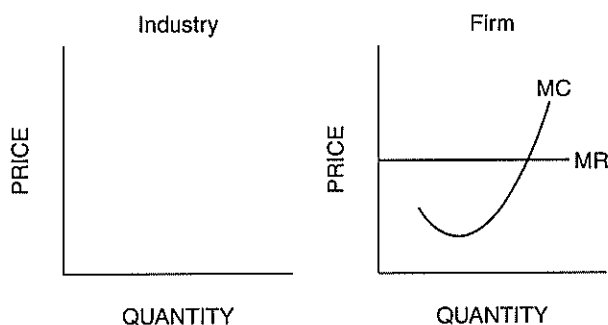
- (A) For the industry's graph, draw the supply (S) and demand (D) curves. Indicate by  $P^*$  and  $Q^*$  the equilibrium price and quantity.
- (B) For the firm's graph, draw the average total cost (ATC), average variable cost (AVC), average revenue (AR), and demand (D) curves. Indicate by  $P^*$  and  $Q^*$  the firm's optimal price and output.
- (C) Explain the reasoning for your graphs in each situation.

1. A firm earning positive total profit in the short run.



Figure 3-9.1

### Short-Run Economic Profit



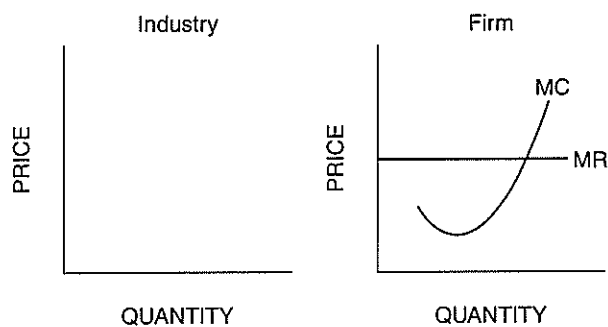
Explanation:

2. A firm operating with an economic loss but not wanting to shut down in the short run.



Figure 3-9.2

**Short-Run Economic Loss but Not Shutting Down**



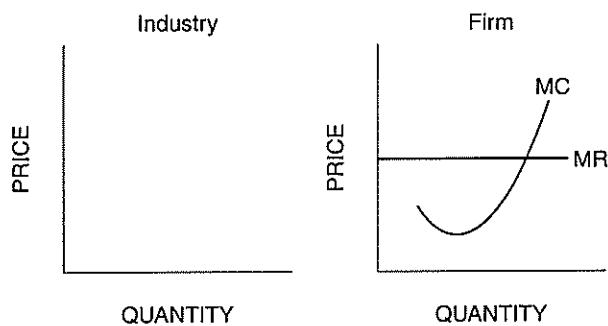
Explanation:

3. A firm in a classic shutdown position in the short run.



Figure 3-9.3

**Classic Shutdown Position**



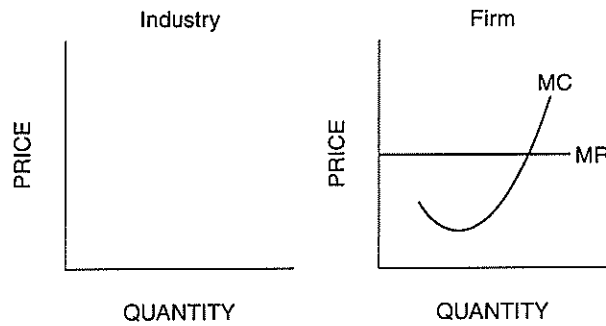
Explanation:

4. LRE for a firm and the industry.



Figure 3-9.4

**Long-Run Equilibrium**



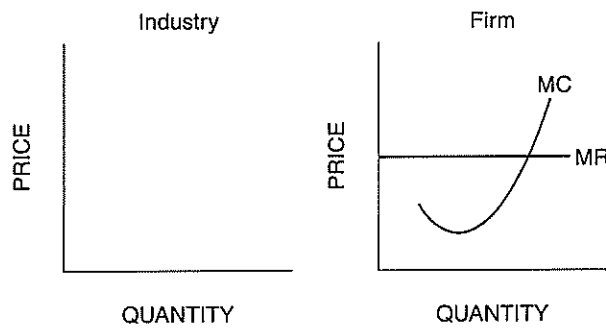
Explanation:

5. Illustrate how economic profits will disappear in the long run.



Figure 3-9.5

**From Short-Run Profit to Long-Run Equilibrium**



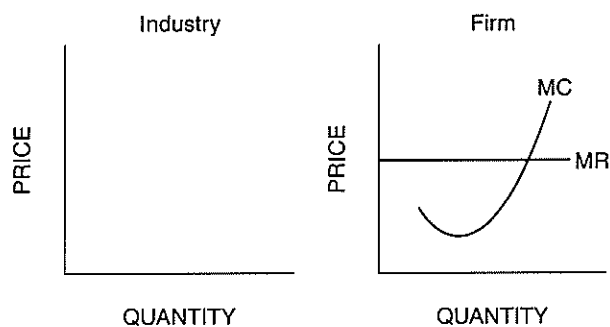
Explanation:



6. Illustrate how economic losses will disappear in the long run.



Figure 3-9.6  
From Short-Run Loss to Long-Run Equilibrium



Explanation: